
FINAL REPORT AAFC-1

Status and Assessment of Pilot Watershed Study Data

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**Compilation of a Computerized Database using Data Assembled under the
Pilot Watershed Study of the Soil and Water Environmental
Enhancement Program (SWEEP)**

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EXECUTIVE SUMMARY

This paper is the first in a series of reports concerning data assembled during the Pilot Watershed Study (PWS), a major component of the Soil and Water Environmental Enhancement Program (SWEEP). As part of the PWS, a variety of materials have been delivered to the Ontario Land Resource Unit (OLRU) of Agriculture Canada by BEAK Consultants, Ecologistics, and Ecological Services for Planning, the contractors involved in implementing the PWS.

The purpose of this report is to assess and document the digital data received from the PWS which i) have potential application to the Indicators of Risk of Water Contamination (IROWC) project at the OLRU (MacDonald and Spaling 1995a,b), and which ii) are appropriate for incorporation into the OLRU database. The paper documents the types of digital data available, assesses their spatial and temporal resolution and accuracy, and estimates the degree to which data layers can be integrated. The paper concludes that the spatial coverages and associated attribute information can be readily integrated, and that the PWS database will prove quite useful in assessing IROWC at a variety of temporal and spatial scales.

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1. INTRODUCTION

Heightened awareness of environmental problems associated with human activities has stimulated a flurry of research by government agencies and the academic community on indicators of environmental health. Accordingly, Agriculture and Agri-Food Canada (AAFC) has established a research initiative to develop agri-environmental indicators for Canadian agriculture (AAFC 1994). Several potential indicators have been proposed, including water quality. The Ontario Land Resource Unit (OLRU) of AAFC has been mandated to develop concepts and procedures for assessing risk of water contamination from agricultural activities at various spatial scales (MacDonald and Spaling 1995a,b). At larger scales of resolution (smaller geographic areas), data assembled under the Pilot Watershed Study (PWS) may prove quite useful for this purpose.

The Pilot Watershed Study was undertaken from 1987 to 1992 as part of the Soil and Water Environmental Enhancement Program (SWEEP). It was designed to evaluate the effects of established conservation farming practices on a variety of agri-environmental attributes (e.g. soil properties and water quality) at the field, farm and small watershed scales. The PWS was implemented within three southwestern Ontario, Lake Erie sub-watersheds (Essex, Kettle Creek, and Pittock), using paired test (conservation oriented) and control (conventional practice) basins within each to assess the influence of conservation practices. The location and a general description of the study areas is provided in SWEEP Report No. 1 (BEAK and Ecologistics 1994). This summary information includes data on general soil characteristics, slope, drainage characteristics, areal extent, number of farms, average farm size, and area in agricultural use. Most of this information is based on the raw digital data which now forms part of the OLRU database.

The implementation of the PWS resulted in the gathering of a voluminous quantity of data pertaining to climate, conservation practices, crops, soils, hydrology, and water quality (BEAK and Ecologistics 1994; BEAK 1994a,b; Ecologistics 1994a,b). In addition, a detailed soil survey of the pilot watersheds was carried out (Ecological Services for Planning (ESP) 1990).

These data, in raw print and digital form, are directly relevant to the IROWC project (MacDonald and Spaling 1995a,b). However, the data exist in varied formats which must be standardized and incorporated into the OLRU database before their full potential can be realized. The first step in this process was to systematically assess and document the data available in digital form.

1.1 Objectives

This report documents the nature and quantity of data gathered during the Pilot Watershed Study of the Soil and Water Environmental Enhancement Program available in digital form. Specific emphasis is placed on those data which i) have potential application to the Indicators of Risk of Water Contamination (IROWC) currently being developed by MacDonald and Spaling (1995a,b), and which ii) are appropriate for incorporation into the OLRU database. The location of the digital data is documented in Appendix A.

1.2 Assumptions

The recommendations given in this report stem from two discussion papers on IROWC by MacDonald and Spaling (1995a,b) which establish the theoretical and methodological justification for selecting particular types of data relevant for calculating risk of water contamination. MacDonald and Spaling (1995b) argue for a combination of a budget approach and spatial analysis as a potential method for determining IROWC. This determines the type of information appropriate for the task, while the subsequent incorporation of this information into the OLRU database depends on practical considerations and technical limitations.

The first step in the budget approach to IROWC outlined by MacDonald and Spaling (1995b) argues that the **Potential Contaminant Concentration (PCC)** is a function of **Potential Contaminant Present (PCP, kg/ha)** relative to the amount of **Excess Water (EW, l/ha)** present. In turn, each of these components is considered to be a function of several factors:

$PCP = f(\text{climate, crop, input, soil, management...})$

$EW = f(\text{crop moisture use [yield], precipitation, evaporation})$

MacDonald and Spaling (1995a) also note that the relative importance and measurability of factors which influence the PCP vary at different levels of hierarchical organization, e.g. regional level, farm unit, individual plot. The data gathered during the PWS pertain primarily to the small watershed scale (approx. 400 ha) or lower, corresponding to levels 1-3 of the 7 level hierarchy suggested by MacDonald and Spaling (1995a).

The ensuing sections describe the nature of data collected in the PWS and, based on the budget approach described above, assess the feasibility of incorporating them into the OLRU database.

2. STATUS AND ASSESSMENT OF DATA

2.1 Climate

A variety of climatic parameters were gathered throughout the life of the PWS, from a number of monitoring sites. Meteorological stations were located in test and control sub-watersheds, however, their precise location is only available in print form and is noted in BEAK and Ecologistics (1994). Primary weather stations were located at the site office in each watershed (not sub-watershed); secondary weather stations were located at the mouth of the sub-watersheds; and additional rain gauges were distributed in the pilot watersheds to address the spatial distribution of precipitation. In addition, data from several other sources (Atmospheric Environment Service, Conservation Authorities, etc.) were used to augment the meteorological data. Unfortunately, no information was given as to how these disparate sources of climate data were amalgamated and integrated into the final form reported in BEAK and Ecologistics (1994). These data (e.g. temperature, rainfall), collected over a four year period, are available in both print and digital format and have been incorporated into the OLRU database (Table 1).

Data were reported at the **overall watershed level**, and were not disaggregated into test and control sub-basins. The **actual sub-basin values** for temperature, rainfall, etc. are therefore unknown, but are assumed to approximate the values given at the overall watershed level. This results in a relatively small degree of error, since the sub-basins are closely spaced.

These data can, therefore, be used to characterize the general climatic conditions for the three sample watersheds and relate primarily to the excess water component of IROWC (MacDonald and Spaling 1995b). Since hourly measurements of climate-related data are available in digital format, it will be possible to implement IROWC at a variety of temporal (hourly, daily, monthly, seasonally), and consequently, spatial (field, micro-basin, sub-watershed) scales.

2.2 Crops and Conservation Practices

As noted in Table 2, print and digital data pertaining to area, crop type, tillage, residue cover, and yield are available at the individual field level on an annual basis (1989, 1990, 1991). These raw data have also been aggregated to the sub-watershed level and are reported in SWEEP Report No. 4 (Ecologistics 1994b). Originally, a complete inventory of the spatial boundaries of farm fields was found neither in any of the SWEEP reports, nor in digital format. Field boundary maps were eventually discovered among the

plethora of SWEEP materials forwarded to the OLRU from Ecologistics. These maps have since been digitized and the complete set of spatial field boundaries (1989, 1990, 1991) and their associated attribute information now resides in the OLRU database.

This crop-related information provides an indication of the management practices associated with crop types. This information could be used to estimate the types of inputs being used and typical application levels which may lead to water contamination.

Data on conservation practices and structures are reported on an annual basis at the spatial resolution of test and control watersheds. These data pertain to management structures and practices which mitigate or filter potential contaminants, thus, they relate primarily to the potential contaminant present component of IROWC. Maps indicating the location of buffer strips and areas seeded to hay, as well as other conservation structures, are provided in SWEEP Report No. 4 (Ecologistics 1994a). However, these maps are of insufficient quality to include in the OLRU digital database.

2.3 Soils

As indicated previously, a detailed soil survey of the pilot watersheds was undertaken during the initial stages of the PWS (Ecological Services for Planning 1990). The data generated from this endeavour represents a comprehensive database in its own right. ESP has produced paper maps of the study areas depicting the location of the soil polygons, soil benchmark monitoring sites and the cesium benchmark sites, as well as accompanying attribute information in print format and in digital dBase format.

The soils maps have since been digitized by the contractor. In the future, if required, the entire soils database can be incorporated into the OLRU SWEEP database. However, at this stage, only the basic data pertaining to the soil polygons (soil type, texture, slope, drainage, etc.) have been transferred (the "LEGEND" files from ESP 1990).

Table 3 describes the soil properties which were measured **annually** at the benchmark sites throughout the life of the PWS. Each benchmark site (assigned a name such as ET1, ET2, etc. in the OLRU database) actually contains 2 or 3 sub-plots, each plot corresponding to a different slope position within the greater benchmark site. This results in a total of 38 (mini) benchmark sites. The location of these individual plots has not been included in the OLRU database but can be referred to in ESP (1990). These sites were situated on representative soils and slopes within test and control watersheds. Of the 38 sites, 18 were chosen for additional **seasonal** monitoring of selected soil parameters (Table 3).

Since the soil polygons, soil benchmark sites and the field boundaries are registered to a common base (the sub-watershed boundary) they can be readily overlaid with one another (Report 3 in this series describes the integration of coverages in more detail). Ecologistics (1994b) has already summarized this information by providing crop and management information associated with the benchmark sites.

2.4 Hydrology

Watershed Scale

Hourly discharge was monitored at each sub-watershed outlet for the duration of the PWS. These digital data are now included in the OLRU database, and are also reported in SWEEP Report No. 5 (BEAK 1994a) as daily values. Hydraulic yield (runoff as a percentage of precipitation) is also provided in print form. Discharge data can be related to crop, management and soils information discussed earlier.

Depth to groundwater was measured at two sites within each sub-watershed which were located in close proximity to micro-basin monitoring stations. The locations of the sites are documented in SWEEP Reports 5 and 6 (BEAK 1994a,b) and have been added to the OLRU digital database.

Micro-basin Scale

Discharge was also measured at the micro-basin level, with 2 micro-basins designated per sub-watershed. Monitoring devices were located in shallow ditches, at road culverts or at drop inlet structures. Daily discharge was monitored at respective micro-basin outlets. The locations of micro-basins have been digitized and are also shown in SWEEP Report No. 5 (BEAK 1994a). Associated data on micro-basins (e.g. crop, slope, soil type) can be determined by overlaying the appropriate coverage. In fact, some of this information already exists in print form (BEAK 1994a).

Plot Scale

Rainfall simulations were carried out on three, 1m² plots within each sub-watershed (Table 4). These were administered during different cropping periods: post-tillage (fall), post-harvest (fall), and pre-plant (spring). Three hydrological parameters were measured: time to ponding, time to runoff, and runoff volume. These data are available in both print and digital form, but have not been included in the OLRU database as the spatial location of the plots is unknown. Details such as crop type, soil type and residue for each simulation, as well as the simulation methodology, are given in BEAK (1994a).

2.5 Water Quality

Water quality was monitored in conjunction with the hydrological parameters described above, i.e., samples of runoff water taken from the various locations noted above, were tested for the water quality parameters described in this section.

Watershed Scale

Water quality parameters measured at the scale of test and control watersheds are detailed in Table 5. The parameters were measured during at least 10 **runoff events** per year, distributed over the spring snowmelt, late spring, summer and fall runoff periods. Water samples were collected on an hourly basis (approximately) through the duration of each runoff event. Monthly, inter-event samples were also gathered. These data have been incorporated into the OLRU database.

From these samples, daily loadings of suspended solids and phosphorous have also been estimated. These data are documented in SWEEP Report No. 6 (BEAK 1994b) and are also available in digital format. However, the format of the loadings files (awkwardly formatted ASCII text) requires a substantial amount of manipulation to make them useable, and so they have not been included in the OLRU database.

Micro-basin Scale

Water quality was also assessed at the micro-basin level (Table 5). Water quality samples were gathered in approximately the same manner as at the watershed scale noted above. Concentrations of suspended solids and phosphorous were monitored via 2-10 samples per runoff event at each micro-basin site and have been recorded in the OLRU database. Micro-basin water quality data can be associated with climate, crops, soils and hydrological data to assess IROWC at this scale.

Loadings of suspended solids and phosphorous were estimated and reported in SWEEP Report No. 6 (BEAK 1994b). As with watershed scale water quality data, the estimated values for suspended solids and phosphorous loadings were not incorporated into the OLRU database.

Plot Scale

Runoff generated in the rainfall simulations described in section 2.4 was analyzed for suspended solids concentration and phosphorous concentration. As with the plot scale hydrological data, simulation water quality data is available in digital format, but has not been incorporated into the OLRU database. Related data pertaining to rainfall simulation sites include slope, antecedent moisture, and residue, which may be useful for estimating IROWC at this scale (refer to BEAK 1994a,b).

3. SUMMARY AND CONCLUDING DIRECTIONS

This report supplements the existing SWEEP reports by documenting the nature and quantity of data gathered and reported during the course of the Pilot Watershed Study available in digital format. The PWS reports contain a wealth of information which may be of potential use in follow-up studies. The current project, Indicators of Risk of Water Contamination, will certainly profit from the data pertaining to climate, conservation practices, crops, soils, hydrology and water quality which have been discussed in this paper. This information is directly relevant to the IROWC at a variety of hierarchical scales proposed by MacDonald and Spaling (1995a), e.g. field, farm, small watershed scale.

A database structure has been designed to integrate the digital PWS data described in this report into the OLRU database, primarily for use with Arc/Info. A subsequent report details the organization of the database and the linkages among data layers. In conjunction with this series of reports, SWEEP reports 4, 5, and 6 may be particularly useful for detailed use of the data.

This paper represents a first step in testing the Indicators of Risk of Water Contamination. In addition to modelling IROWC at lower levels of hierarchical organization, the PWS data will provide the basis for applying the IROWC methodology at regional and, eventually, national levels of the hierarchy.

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TABLES

Table 1. Climate Data.

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Air Temperature	degrees celsius	overall watershed	01/89-06/92	yes	15 minutes; 60 minutes in Kettle	(#) hourly air temperature (&) average daily, monthly and annual temperature; maximum and minimum daily, monthly, and annual temperature
Precipitation	mm	overall watershed	01/89-06/92	yes	15 minutes; 10 minutes in Kettle	(#) hourly precipitation (&) total daily, monthly and annual precipitation; maximum hourly recorded by month and year; maximum daily recorded by month and year
Solar Radiation	langleys	overall watershed	01/89-06/92	missing Apr.-June '92 in Pittock	15 minutes; 10 minutes in Kettle	(#) hourly solar radiation (&) total monthly and annual solar radiation
Wind Direction	degrees from north	overall watershed	01/89-06/92	yes	5 minutes; 15 minutes in Pittock	(#) hourly wind direction
Wind Speed	m/s	overall watershed	01/89-06/92	yes	5 minutes; 15 minutes in Pittock	(#) hourly wind speed (&) average daily, monthly and annual wind speed; maximum daily wind speed by month and year
Relative Humidity	%	overall watershed	01/89-06/92	yes	N/A	(#) daily relative humidity
Soil Temperature	degrees celsius	overall watershed	01/89-06/92	missing Jan. and Feb. '89 in Essex	60 minutes	average daily (#) and monthly (&) soil temperature at depths of 5, 50, and 150 cm

Table 1 Continued

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Corn Heat Units	N/A	overall watershed	1989-1991 Growing season only	yes	N/A	(&) corn heat units
Potential Evaporation	mm	overall watershed	May-Oct. '89-Oct. '91; May-June '92	missing May '89 in Kettle; May '89 and May and June '92 in Pittock	N/A	(&) total monthly evaporation - evaporation pan

data in digital format in OLRU database
& data reported in SWEEP reports or in unusable digital format

Associated SWEEP Report: BEAK and Ecologistics (1994). SWEEP Report No. 1.

Table 2. Crops and Conservation Practices.

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Area	hectares; acres	fields; test and control watersheds	1989-1992	some fields missing values	annual	(#) field area (&) total farm area in Essex, Kettle and Pittock test and control watersheds
Crop Type	N/A	fields; test and control watersheds	1989-1992	some fields missing values	annual	(#) crop type by field (&) % of total reported area by crop type: corn and sunflower, beans and peas, winter wheat, spring cereals, hay, fallow
Tillage	N/A	fields; test and control watersheds	1989-1992	some fields missing values	annual	(#) tillage type by field (&) watershed level: % of total reported area by tillage practice: mouldboard plough, adjusted and modified mouldboard plough, chisel plough, cultivator, disc, no fall tillage, no-till, hay/pasture (no tillage);
Residue Cover	%	fields; test and control watersheds	1989-1992	some fields missing values	annual; post-runoff; post-plant	(#) percent cover by field (&) percent of total farm area in sub-watershed (both at two time points (after spring runoff and after planting)
Yield	kg/ha; bu/ac	fields; test and control watersheds	1989-1992	some fields missing values	annual	(#) yield by field (&) average yield per year in test and control watersheds

Table 2 Continued

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Fertilizer Use (Phosphorous only)	kg/ha	test watersheds	1989 and 1992	yes	N/A	(&) actual amount of phosphorous applied at sub-watershed scale (not available at field level), compared to recommended amount; number of farms reporting, farm area reporting
Conservation Practices	number and area affected	specific sites in test watersheds	1989-1992	yes	N/A - once in place, area remained constant	(&) number of buffer strips and critical areas seeded to hay and farm area affected by these structures in the test watersheds
Conservation Structures	number installed by year	specific sites in test watersheds	1989-1992	yes	annual	(&) number of structures implemented in each year of the study: tile outlet, rock chute, catch basin improvement, channel terrace, diversion waterway/ buffer, grassed waterway, ditch bank repair, buffer area, low level crossing

data in digital format in OLRU database
& data reported in SWEEP reports or in unusable digital format

Associated SWEEP Reports: Ecologistics (1994a,b) . SWEEP Report Nos. 2 and 4.

Table 3. Soils Data.

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Infiltration Rate	(m/s)	benchmark sites ¹	'89-'91	some gaps	annual; seasonal ²	(#&) infiltration rate
Bulk Density	g/cm ³	benchmark sites	'89-'91	some gaps	annual; seasonal	(#&) bulk density at 5, 10, 15, 20, 25, and 30 cm depths; average bulk density 0-15 cm, 15-30 cm (annual)
Soil Moisture Content	% by weight	benchmark sites	'89-'91	some gaps	annual; seasonal	(#&) soil moisture content, 0-30 cm depth
Particle Size Distribution	%	benchmark sites	'89-'91	some gaps	annual; seasonal	(#&) % gravel, very coarse sand, coarse sand, medium sand, fine sand, sand, silt, clay (calgon dispersed; sampled annually; water dispersed; sampled seasonally)
Biological Activity Index	mg/kg (microbial biomass)	benchmark sites	'90-'91	yes	seasonal	(#&) reported for 1990 post-harvest; 1991 pre-plant, post-plant, post-harvest
Plasticity Index	N/A	benchmark sites	'89-'91	some gaps	annual	(#&) plasticity index, 0-15 cm and 15-30 cm depths
Organic Matter Content	%	benchmark sites	'89-'91	some gaps	annual	(#&) post harvest organic matter content

Table 3 Continued

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Wet Aggregate Stability	%	benchmark sites	'89-'91	some gaps	annual	(#&) wet aggregate stability
pH	pH	benchmark sites	'89-'91	some gaps	annual	(#&) pH values
Cation Exchange Capacity	meq/100g	benchmark sites	'89-'91	some gaps	annual	(#&) post harvest CEC
Calcium Carbonate	%	benchmark sites	'89-'91	some gaps	annual	(#&) % calcium carbonate
Moisture Retention Values	% by mass	benchmark sites	'89-'91	some gaps	annual (alternate years)	(#&) saturated, 100mB and 15 Bar; 0-15, 15-30 cm depths

¹benchmark sites distributed in test and control watersheds (see text)

²seasonal monitoring = early spring (thaw, pre-plant), late spring (post-plant), and fall (post-harvest).

data in digital format in OLRU database

& data reported in SWEEP reports or in unusable digital format

Associated SWEEP Report: Ecologistics (1994b) . SWEEP Report No. 4.

Table 4. Hydrological Data.

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Hourly Discharge	cubic dm	test and control watersheds	01/89-06/92	some minor gaps	hourly	(#) hourly discharge (&) total daily, monthly, seasonal and annual discharge
Hydraulic Yield	%	test and control watersheds	01/89-06/92	yes	N/A	(&) seasonal and annual hydraulic yield (hydraulic yield = runoff as percentage of precipitation)
Depth to Groundwater	cm	groundwater monitoring sites	May '89 - June '92	some minor gaps	3-4 samples per month	(#&) average monthly depth to groundwater
Daily Discharge	m ³ /d	micro-basins	01/89-06/92	yes	daily	(#&) total daily discharge for micro-basins
Time to Ponding	seconds	plot scale (1m ²) rainfall simulations	fall '90 - spring '92	N/A	5 times at 3 plots in each sub-basin	(\$) time to ponding during rainfall simulations under various cropping/tillage situations: post-tillage (fall), post-harvest (fall), and pre-plant (spring)
Time to Runoff	seconds	plot scale (1m ²) rainfall simulations	fall '90 - spring '92	N/A	5 times at 3 plots in each sub-basin	(\$) time to runoff during rainfall simulations under various cropping/tillage situations: post-tillage (fall), post-harvest (fall), and pre-plant (spring)
Runoff Volume	ml	plot scale (1m ²) rainfall simulations	fall '90 - spring '92	N/A	5 times at 3 plots in each sub-basin	(\$) total runoff during rainfall simulations under various cropping/tillage situations: post-tillage (fall), post-harvest (fall), and pre-plant (spring)

data in digital format in OLRU database
& data reported in SWEEP reports or in unusable digital format
\$ data in useable digital format; not in OLRU database

Associated SWEEP Report: BEAK (1984a). SWEEP Report No. 5.

Table 5. Water Quality Data.

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Suspended Solids	mg/l	test and control watersheds; micro-basins	01/89-06/92	N/A	selected events	(#) suspended solids concentration in selected water samples (&) average and median suspended solids concentration, reported seasonally and annually (&\$) estimated suspended solids loads reported daily, seasonally and annually
Phosphorous	mg/l	test and control watersheds; micro-basins	01/89-06/92	N/A	selected events	(#) phosphorous concentration in selected water samples (&) average and median phosphorous concentration, reported seasonally and annually (&\$) estimated phosphorous loads reported daily, seasonally and annually
Filtered Reactive Phosphorous (FRP)	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#) FRP concentration in selected water samples (&) average and median filtered reactive phosphorous concentration, reported seasonally and annually (&\$) estimated FRP loads reported daily, seasonally and annually
Ammonia	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) ammonia concentration in selected water samples

Table 5 Continued

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Total Kjeldahl Nitrogen (TKN)	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) TKN concentration in selected water samples
Nitrite	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) nitrite concentration in selected water samples
Nitrate	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) nitrate concentration in selected water samples
pH	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) pH values for selected water samples
Chloride	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) chloride concentration in selected water samples
Potassium	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) potassium concentration in selected water samples
Conductivity	mg/l	test and control watersheds	01/89-06/92	N/A	selected events	(#&) conductivity of selected water samples
Suspended Solids Concentration and Load	mg/l and g/m ²	plot scale (1m ²) rainfall simulations	fall '90 - spring '92	N/A	5 times at 3 plots in each sub-basin	(#&) suspended solids concentration and area suspended solids load during rainfall simulations under various cropping/tillage situations: post-tillage (fall), post-harvest (fall), and pre-plant (spring)

Table 5 Continued

Attribute	Units	Spatial Resolution	Duration of Collection	Completeness	Sampling Frequency	Measures Reported
Phosphorous Concentration and Load	mg/l and g/m ²	plot scale (1m ²) rainfall simulations	fall '90 - spring '92	N/A	5 times at 3 plots in each sub-basin	(&\$) phosphorous concentration and area phosphorous load during rainfall simulations under various cropping/tillage situations: post-tillage (fall), post-harvest (fall), and pre-plant (spring)
Groundwater Phosphorous Concentration	mg/l	groundwater monitoring sites	approx. 06/89-06/92	N/A	3-4 samples per month	(&\$) groundwater phosphorous concentration per sample

data in digital format in OLRU database
 & data reported in SWEEP reports or in unusable digital format
 \$ data in useable digital format; not in OLRU database

Associated SWEEP Report: BEAK (1994b). SWEEP Report No. 6.

APPENDIX A

Location of Pilot Watershed Study Digital Data

The entire set of digital data gathered during the course of the PWS has been archived on diskettes found in the pocket at the end of this report. Included are comma delimited text files which were used to create the Arc/Info database, as well as various files in Quattro Pro, Lotus, and dBase format. Individual ZIP files have been created for each study area, e.g. ESSEX.ZIP, KETTLE.ZIP, PITTOCK.ZIP. The collection is also located on the network in an H:\ drive sub-directory to allow easy access.